CLAIMS

1. A process for the reduction of the level of a component in a feed gas comprising passing the feed gas to at least three parallel thermal swing adsorption zones, each zone containing an adsorbent and being operated in an adsorption cycle which comprises an adsorption step to remove or to reduce the level of the component from the feed gas and in which the feed gas is fed continuously to the adsorption zone during the adsorption step, depressurisation of the adsorption zone, a regeneration step to desorb the adsorbed component and repressurisation of the adsorption zone, wherein the adsorption cycle of each zone is phased with respect to that of the other zones so that at any point during the adsorption cycle, the number of zones in the adsorption step is greater than the number of zones not in the adsorption step.
2. A process as claimed in claim 1 in which the feed gas from which the undesired component has been removed is fed to a downstream cryogenic separation process.
3. A process as claimed in claim 1 or claim 2 in which the feed gas is selected from synthetic gas, natural gas and air.
4. A process as claimed in claim 1 in which the absorbent is selected from alumina, silica gel, activated alumina, impregnated alumina, and a molecular sieve.
5. A process as claimed in claim 1 in which the undesired components comprise carbon dioxide and water and the adsorbent comprises a first adsorbent selected from silica gel, activated alumina, impregnated alumina and alumina and a second, downstream adsorbent comprising a zeolite.
6. A process as claimed in claim 5 in which the zeolite is selected from a zeolite of the X type , A type, LSX type having a silicon to aluminium ratio of 1.0 to 1.25.
7. A process as claimed in claim 1 in which the feed gas is at a temperature of –50 to 80°C.
8. A process as claimed in claim 7 in which the feed gas is at a temperature of 5 to 50ºC.
9. A process as claimed in claim 1 in which the regeneration of the adsorbent is carried out at a temperature of 0 to 400°C.
10. A process as claimed in claim 1 in which the adsorbent is regenerated by means of a regeneration gas and the molar ratio of regeneration gas to feed gas is 0.05 to 0.8.

11. A process as claimed in claim 1 in which the regeneration gas is at a pressure of 10000 to 2000000 N/m^2.

12. A process as claimed in claim 1 in which the feed gas is at a pressure of at least 100000N/m^2.

13. A process as claimed in claim 12 in which the feed gas is at a pressure of 200000 to 4000000 N/m^2.

14. A process as claimed in claim 1 in which the feed gas is at a temperature of 5 to 50ºC and a pressure of 200000 to 4000000 N/m^2.

15. A process as claimed in claim 1 in which the pressure of the gas being fed to the adsorption step is substantially constant.

16. A process as claimed in claim 1 in which repressurisation of the an adsorption zone is effected by feeding to the zone a gas at higher pressure from upstream of the adsorption zone.

17. A process as claimed in claim 1 in which the adsorption cycle for all the adsorption zones is substantially the same duration.

18. A process as claimed in claim 1 in which the ratio of the duration of the adsorption step to the adsorption cycle is not less than the ratio of one less than the number of adsorption zones to the number of adsorption zones.

19. A process as claimed in claim 1 having three adsorption zones.

20. A process as claimed in claim 1 in which the number of zones in the adsorption step at any point during the cycle is one fewer than the total number of adsorption zones.

21. A thermal swing adsorption apparatus for conducting thermal swing adsorption of a component in a feed gas, the apparatus comprising at least three parallel thermal swing adsorption zones adapted to receive an adsorbent bed and means for controlling the flow of the feed gas through the at least three zones such that each bed undergoes repeated adsorption cycles which cycle comprises an adsorption step to remove or to reduce the level of the component from the feed gas and in which the feed gas is fed continuously to the adsorption zone during the adsorption step, depressurisation of the zone, a regeneration step to desorb the adsorbed component and repressurisation of the adsorption zone, and wherein the adsorption cycle of each zone is phased with respect to that of the other zones so that, in use, the number of zones in the adsorption step is greater than the number of zones not in the adsorption step.

22. A thermal swing adsorption apparatus comprising at least three adsorption vessels, a feed gas inlet assembly in fluid communication with each vessel, an outlet assembly in fluid communication with the at least three vessels being arranged in parallel paths, flow control means to permit the feed gas to pass through each vessel and to the outlet assembly, a regeneration assembly comprising a conduit in fluid communication with the outlet assembly whereby a regeneration gas is able to be passed into each vessel and a heater to heat the regeneration gas, the flow control means and the regeneration assembly being arranged so that each vessel, in use, repeatedly undergoes an adsorption cycle comprising an adsorption step, depressurisation, a regeneration step and repressurisation and the adsorption cycle for each vessel is out of phase with the cycle for all the other vessels provided that, in use, at least two vessels are in the adsorption step at any time and the flow control means feeds the feed gas continuously to the adsorption zone during the adsorption step.

23. Apparatus as claimed in claim 21 or claim 22 in which the adsorption zone is defined by a vessel selected from a horizontal, vertical and radial bed vessel.

24. Apparatus as claimed in claim 21 or claim 22 in which the means for controlling the flow of feed gas comprises conduits for gas flow in or connecting the zones and connecting each bed to a source of the feed gas and to an outlet from the apparatus for the gas treated by removal or reduction of the undesired component, valve means in the conduits operable to open and close respective ones of the conduits.

25. Apparatus as claimed in claim 21 or claim 22 in which the means for controlling the flow of gas comprises valve control means programmed to operate the valve means in sequence to produce the required adsorption cycles of operation.

26. A process for the reduction of the level of a component in a feed gas comprising passing the feed gas to apparatus as claimed in claim 21 or claim 22 and carrying out a process as defined in claim 1.